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Small cell siting: regulatory and deployment considerations

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Solving the HetNet puzzle

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The theme of Release 9 is Commercializing Hyperdense HetNets, which looks at practical solutions to help operators transform their network capacity and performance, and which are deployable and cost-effective right now.

The Small Cell Forum Release Program website can be found here:
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Scope

The successful delivery of dense HetNets depends on the collaboration of a large number of stakeholders – regulators, administrations, municipal authorities, site owners, operators and vendors. This document aims to outline the ways in which these stakeholders can cooperate to fulfil the maximum potential of small cells. It also aims to raise awareness among the stakeholders, ranging from equipment producers, operators, integrators, policy makers, and local administrations, that are involved in the approval, acceptance and roll out of the small cells layers of the mobile networks.

Executive summary

Ubiquitous, high speed mobile broadband is proven to have a significant impact on a country's economic competitiveness and social prosperity. For instance, a 10 per cent expansion in mobile penetration increases productivity by 4.2 percentage points, according to one report [1].

As traffic levels rise, and as more industries and cities become always-connected, the mobile networks will have to be designed in a new way. Notably, they will involve very large numbers of small cell base stations, which can deliver massive broadband capacity in urban areas and reach every corner of the country too.

Small cells, then, can achieve the mobile broadband objectives set by governments and cities round the world more effectively than traditional networks alone. They are a critical enabler of 4G densification and of 5G, and therefore of many services which governments are targeting to drive socio-economic change, whether those are for consumers, enterprises or the Internet of Things (IoT).

However, to achieve this potential, significant new approaches are needed in the regulatory and administrative processes which govern mobile deployments. Getting huge numbers of small cells into the right sites timely and affordably is essential, but to date, such programs have often been held back by cumbersome and outmoded processes at several levels:

- Approvals and certification for small cell equipment
- Approvals for site usage and deployment
- Infrastructure and spectrum sharing rules
- Radiofrequency compliance rules

The small cell industry has made a great deal of progress in easing deployment and the SCF Release Program provides operators with a template to roll out dense networks in a scalable, repeatable way. However, the goals above will only be met in full with a combined effort by regulators, administrations, municipal authorities, site owners, operators and vendors.

This document aims to outline the ways in which these stakeholders can cooperate to fulfil the maximum potential of small cells. It also aims to raise awareness among the stakeholders, ranging from equipment producers, operators, integrators, policy makers, and local administrations, that are involved in the approval, acceptance and roll out of the small cells layers of the mobile networks.

Regulators and administrations have a major role to play in enabling frameworks which will ease deployment now and for 5G, driving significant socio-economic benefits. As the commercial and socio-economic need for dense mobile capacity and universal coverage becomes urgent in many areas, authorities around the world are starting to respond. Some innovative new approaches to small cell deployment and regulation are emerging, which will help create best practice examples.

One of the most critical steps is to support a universal set of classifications for equipment and promote it internationally when defining regulation and administrative rules, including exemption or lighter approval rules.

Other common issues underpin every deployment, but Small Cell Forum believes that consensus could be reached with sufficient discussion and openness. Collaborating

with 5G Americas and the GSMA, the Small Cell Forum is committed to encourage a globally consistent regulatory environment favorable to fast and economic roll outs of hyper dense networks.

The checklist below highlights those core issues and potential solutions, which will be detailed in full in the report:

Key challenge	SCF Recommended solutions
Streamlining the regulatory approval for small cell equipment	Standard industry classifications of equipment with common documentation of compliance and conformity to be used when defining related policies; some of these classes can be exempt from approval process or to light regulatory regime.
Scaling the planning application process to support large numbers of cells	Common rules on which equipment classes can be exempt or subject to fast track approval; batch process for groups of cells, to decrease the approval time and reduce workload of local administrations.
Securing sufficient suitable sites with power and backhaul	Simplified common frameworks to ease the opening up the access to street furniture and other existing assets. Census of available assets per municipality. Open access to administrative buildings.
Cost of installation	Adopt simplified rules of installation that would enable non-skilled workers to deploy (based on classes of equipment and complexity of installation). Reduce administrative charges (e.g. installation, operation, periodical revision taxes).
Radiofrequency compliance	Follow international recommendations for installation classes and provide information
Administrative complexity	Single executive to coordinate all approvals (e.g., in a smart city program) Streamlined paperwork and filing to minimize the approval processes and reduce the workload of the administration.

In order to facilitate large-scale small cell deployments, the following recommendations, based on evolving best practice round the world, are proposed for consideration by regulators, administrations and municipalities. These will be the focus of the report:

- Simplified procedures to optimize administrative flows of documentation processing
- Generic declaration of equipment at national/regional/local level
- Generic certification of equipment: internationally standardised accepted classes of equipment with installation rules/manuals => avoid additional documentation
- Generic permits for installation and operation
- Generic installation permissions (vs. site-by-site) and franchises for installation
- Building permits & access to public domain rights of ways: generic authorizations to access administration facilities, single applicable documentation form at national/state level
- Exemptions based installation based on generic criteria: antenna height, power levels, combination of power and height, on a regional-based level
- Environmental considerations: installation of equipment in manner sympathetic to the surrounding environment
- Taxation and fees regime proportionate to the administrative requirements

- Incentives for deployment of greener and environmental friendly equipment
- Lower/exempt taxation and local fees to encourage deployments -> alignment of rental fees with those of other 'essential' infrastructure (water, electricity, gas)
- New roles at the local level: new entities to handle the entire process, authorizations, certifications (operators' third parties, administrative staff)

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1. Introduction: Why mobile broadband is critical

Mobile broadband has a significant impact on a country's economic performance and social inclusion. It can boost competitiveness for cities or whole nations, which is why so many governments have put ubiquitous, fast mobile connectivity at the heart of their digital policies, moving to open up more spectrum and initiate national broadband plans.

Broadband speeds and availability have been shown, in study after study, to drive digital inclusion, GDP and economic growth. In many cases, mobile broadband can be deployed more cheaply and flexibly, and supports a wider range of use cases than fixed-only.

A report by the GSMA, Deloitte and Cisco [1], concluded that:

- A doubling of mobile data use leads to an increase of 0.5 percentage points in GDP per capita growth rates
- Countries characterized by a higher level of data usage per connection have seen an increase in their GDP per capita growth of up to 1.4 percentage points;
- In developing markets, a 10 per cent expansion in mobile penetration increases productivity by 4.2 percentage points.

As an example, a report by Australian regulator ACMA in 2013 [2] (see Figure 1–1) found that:

- productivity growth from the mobile communications sector that led to an increase of \$7.3 billion in Australia's economic activity (GDP)
- time savings for businesses as a result of mobile broadband use that led to a further \$26.5 billion increase in Australia's economic activity.

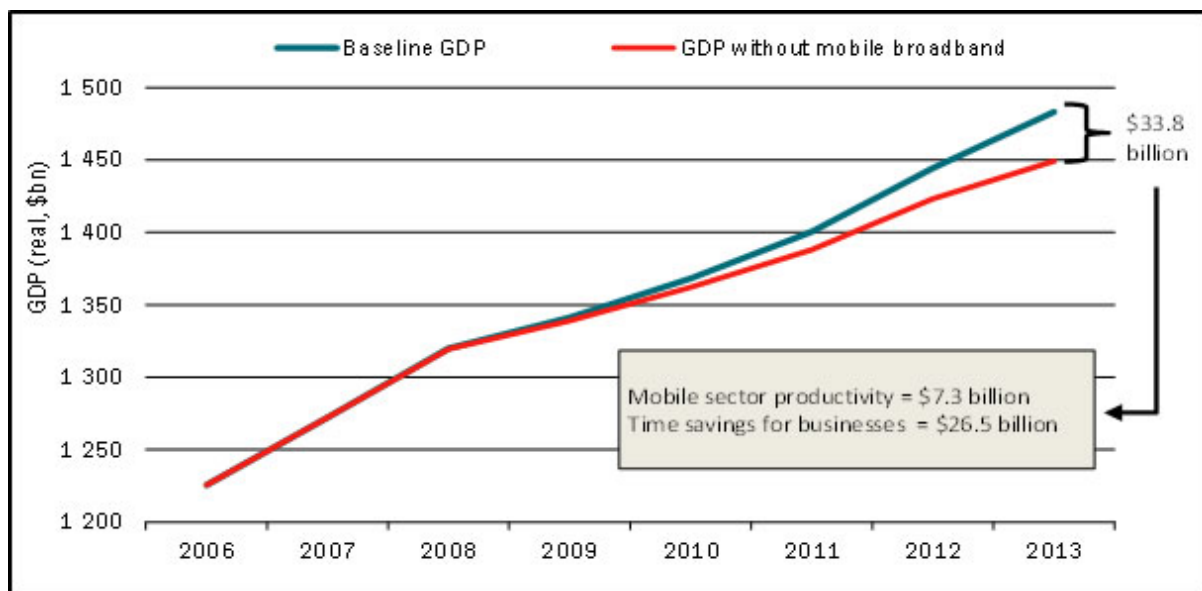


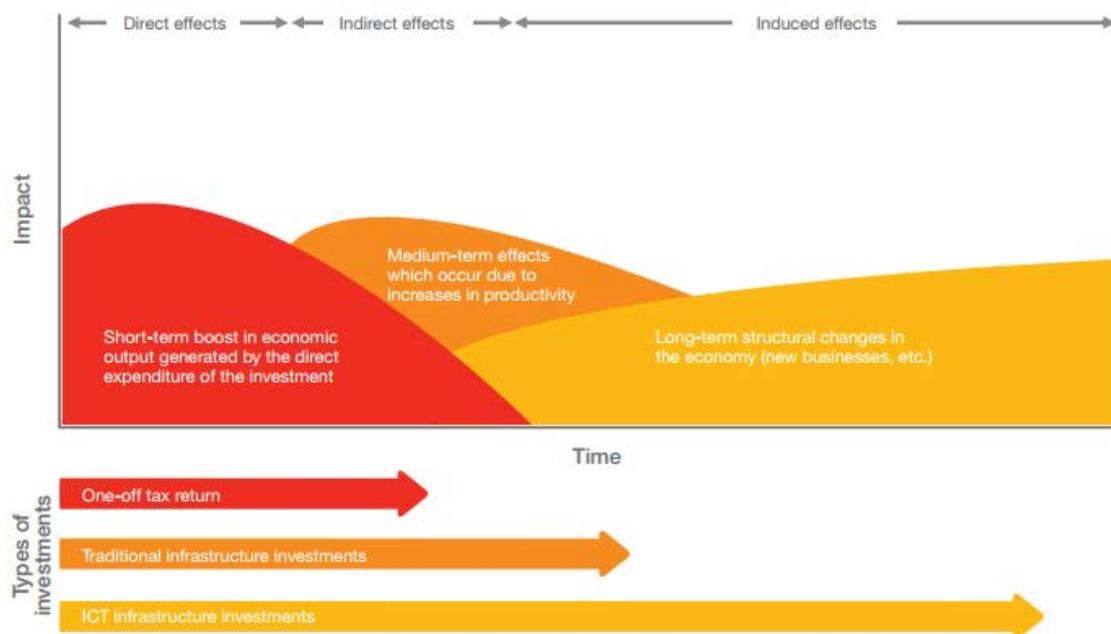
Figure 1–1 The impact of mobile broadband on Australia's GDP in 2013. Source: ACMA

2. The role of small cells in improving the socio-economic case

To deliver and enhance reliable connectivity for citizens and businesses, mobile broadband needs to continuously get faster and more reliable, meaning that network architectures are constantly evolving, densifying, and becoming increasingly focused on small cells. This is because:

- Levels of mobile data traffic are rising at an accelerating rate. This is pushing mobile network operators (MNOs) to adopt new network architectures better suited to handling high volumes of traffic at affordable cost. One of the most important elements is densification – adding to network capacity by building out large numbers of low cost, low power access points or small cells. Because of their large numbers, small cells present new challenges for equipment and site approvals and installation.
- User expectation of the quality of the mobile connection is rising too, as connectivity is becoming essential facility rather than a luxury. Many businesses have adopted mobile-first approaches, while many consumers consider their smartphone as their primary communications tool. This puts additional pressure on regulators to require and operators to build out ubiquitous, reliable networks, often necessitating large numbers of new sites.
- The mobile network will need to support a far wider range of use cases, each with different patterns of traffic and usage, as it evolves towards 5G. In particular, many vertical markets are entrusting key processes to mobile networks as part of their digital transformation, and the Internet of Things (IoT) is envisaged to connect huge numbers of devices within a decade, many of them over mobile connections. Some of these applications will require increases in the geographic coverage of mobile networks, supporting more demanding levels of latency and reliability than have been necessary in 3G and 4G.

Small cells represent a more practical and affordable solution to the request of making high capacity mobile connections truly ubiquitous and reliable. The higher the speed and availability of mobile broadband, the more the economic effect is magnified, as Figure 2–1, from a study by A.D. Little illustrates.



Source: Arthur D. Little research (covering more than 120 reports from leading research institutes)

Figure 2–1 Economic impact of increasing speed and availability of broadband

Source: Ericsson/AD Little [3]

For any authority willing to enable universal broadband and all the socio-economic benefits that brings, small cells may provide a far lower cost alternative to macrocells-only, whether to private operators or state infrastructure programs.

Small cells can contribute to regulatory and policy objectives in several important ways, such as depicted in the Table 2–1 below:

Policy or initiative	Role of small cells
Smart city	Bring the ubiquitous coverage required for services like public safety, traffic management, etc. as they can be deployed in hard-to-reach locations such as underground car parks or even in pavements.
Smart digital community	A blanket of small cells can quickly and cost effectively bring broadband and cloud access to more (small) businesses, stimulating new economic activities.
Bridge digital divide	Provide a more affordable, flexible way to extend coverage to remote and rural areas, and to hard-to-reach urban areas, to enable universal broadband access
Maximize use of spectrum	Increase the spectrum efficiency by reusing the existing mobile operator spectrum for indoor operation, both the currently unused frequencies and those already used by outdoor sites. They can make use of high frequency spectrum as well.
Stimulate new consumer services	The location- and presence-awareness inherent in small cells can support and accelerate new commercial applications such as mobile shopping and context aware marketing, enabling new services.
Emergency response	Small cells can play an important role in providing vital communications for emergency teams. Their localized and dynamic nature helps to meet regulatory requirements placed on national carriers in such circumstances.
Visual integration	Minimised impact on the environment, due to their relatively small and unobtrusive form factor. The visual integration in the surroundings can be further improved if mounted on existing structures such as lampposts, walls, etc.

Table 2–1 The ways in which small cells can support common policy objectives of governments and cities

3. Increasing density makes a new approach urgent

To achieve the coverage and capacity levels required to deliver a fully connected society, small cells need to be deployed in a dense or even hyperdense manner, with some operators planning to roll out 200 or even more cells per square kilometer for high traffic environments like urban city centers and stadiums in the next few years. With 5G, that density will increase further; 5G is envisaged to support one million connections per square kilometer, which could involve 1,000 small cells in some scenarios.

Figure 3–1, from the European Commission's METIS 5G project, provides a high level view of the numbers of different types of cells involved in a next generation dense network.

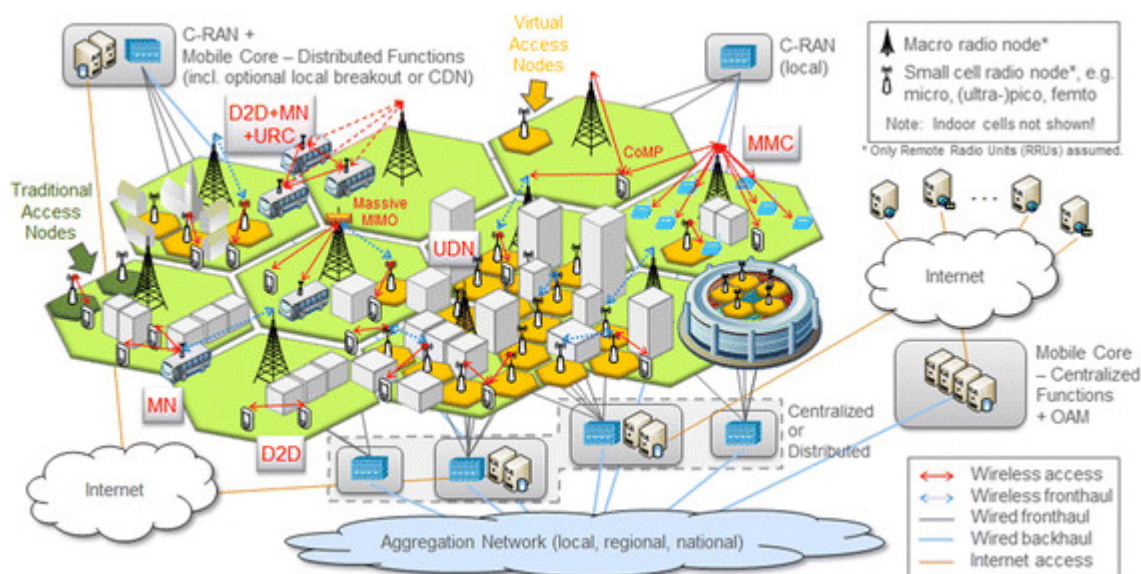


Figure 3–1 A conceptual 5G network. Source: European Commission 5G PPP METIS

Clearly, this will be a very different logistical proposition from deploying a macro cell on a tower or rooftop site. Some of the new approaches relate to the planning and optimization of the network, particularly the increased automation of processes in view of the increasing number of equipment that will need to be installed and put in use. Figure 3–2 indicates the rising percentage of urban or enterprise small cells which will be deployed in dense environments.

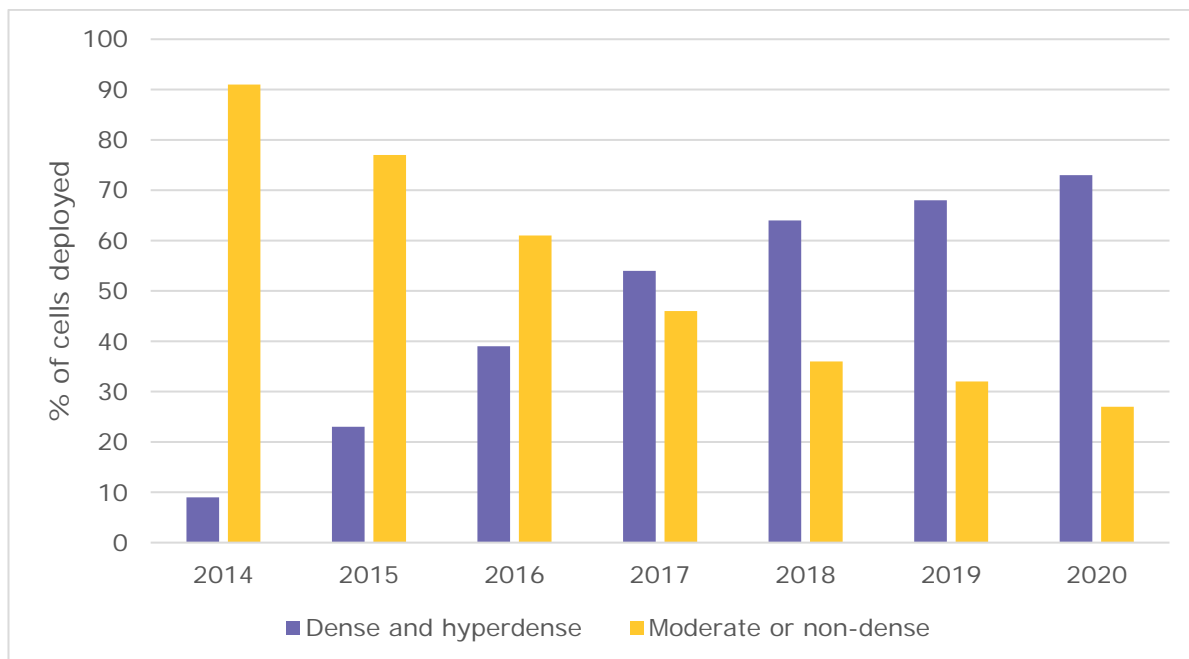


Figure 3–2 Distribution (%) of new small cells deployed by density

Source: Rethink Technology Research forecast [4]

- Low density small cells <20 per square km
- Medium density 20-75 per square km
- Dense 75-200 per square km
- Hyperdense >200 per square km

However, it should be noted that making it easier to deploy small cells is not simply about driving connectivity in an urban context. Easing the regulatory and practical barriers matter just as much in rural and remote contexts. For example, Small Cell Forum commissioned independent experts Real Wireless to assess the business drivers for small cells in rural and remote environments. Real Wireless found that small cells have the potential to deliver affordable mobile broadband coverage to an extra 650 million users worldwide with GDP benefits close to \$1 trillion or an estimated operator benefit of \$163 billion. [\[SCF150\]](#) [5]

The small cell industry has made significant progress in many phases of optimising and automating the deployment process, creating tools and frameworks which simplify the network design, construction, provisioning and optimization activities (for instance, see Small Cell Forum [\[SCF096\]](#) [6]. These technical solutions facilitate installation and reduce deployment time, as well as diminishing the on-the-spot human intervention to solve operational and maintenance activities.

4. Barriers to fulfilling the potential of small cell networks

Additional significant barriers to achieving the goals set in the national and societal policy objectives are to be considered; some relate to cost, whether networks are state-funded or built by private operators, others to technical or commercial factors. But a number of issues are of regulatory nature, arising from the rules and processes governing many aspects of mobile network deployment, from spectrum licensing and usage, to radiofrequency compliance, to site planning and access to right-of-way and property, and taxation.

Enhanced deployment processes and resulting cost reduction would enable even denser networks to be deployed, with even greater impact. Currently, in many cases, even low levels of density are hard to achieve within reasonable timescales and budgets because regulation has not kept pace with the change in network architecture.

Consequently, improvements in operator's tools and approach to deployment and operations cannot overcome all challenges; a supportive planning and regulatory environment is equally important for the desired outcome.

The pressures on regulatory and planning agencies are certainly mounting, as large numbers of sites need to be identified and approved, planning permissions secured and other requirements, such as visual integration and power limits, satisfied. The complexity may vary considerably in different regions.

The smoother and more streamlined these processes can be, the easier it becomes to deploy small cells to a scale at which they will deliver the maximum benefits, within optimal time and cost limits. There is still considerable work to be done to achieve this scalable, repeatable, streamlined approach to planning and approval.

Figure 4–1 shows a simplified deployment process for a public small cell project, from initiation phase to network build-out and optimization.

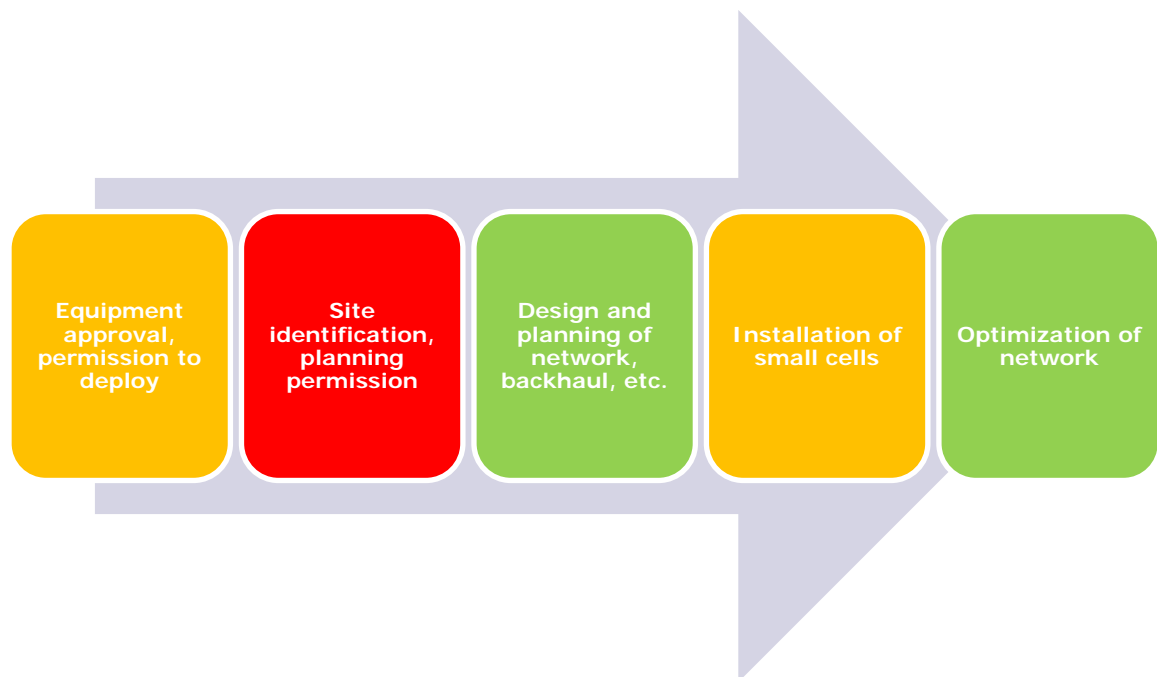


Figure 4–1 Simplified view of the phases of public small cell deployment

Each phase has a colour rating - based on operators' feedback - related to how robust and supportive the tools and processes are to facilitate the respective phase of the process (green = significant; amber = little; red = very little impact). This provides a clear indication that while permissions to deploy and installation procedures are problematic, the operators feel reasonably optimistic about their ability to design, plan and optimize the networks. The greatest bottlenecks are perceived in the area of siting.

Despite the clear drivers for operators to densify their networks to respond to the increasing connectivity and service quality expectations, progress has often been disappointing because of challenges in some stages of the deployment process, which limit scalability and repeatability of the tasks. The key areas where operators report problems which either make deployment difficult or uneconomic, are:

- Gaining permissions to deploy including equipment approval
- Identifying and acquiring sites with backhaul and power
- Rolling out the cells in a repeatable, affordable way
- Addressing radiofrequency exposure compliance
- Supporting neutral host or multi-operator platforms

5. Solutions and best practice

In light of the rising need for dense HetNets to achieve their own national and regional broadband goals, many regulators around the world are devising creative approaches which can provide templates for others.

Further on, this document examines several of the main areas holding back dense small cell deployment, and suggests solutions based on best practice in certain markets, or on ideas coming out of the stakeholders - operator, vendor and regulatory - communities. This, it is hoped, to facilitate a greater dialog between the stakeholders in order to lower barriers, enable scalability, and unleash the social and economic benefits of ubiquitous high capacity mobile broadband.

Based on emerging best practice around the world, the checklist below indicates the main areas where regulatory and administrative authorities can work with operators to create a strong environment to deploy small cells at scale:

- Simplified procedures to optimize administrative flows of documentation processing
- Generic declaration of equipment at national / regional/local level
- Generic certification of equipment: internationally standardised accepted classes of equipment with installation rules/manuals, aimed at avoiding additional documentation
- Exemptions based installation based on generic criteria (e.g.: antenna height, power levels, or a combination of power and height)
- Generic permits for installation and operation
- Generic per batch installation permissions (vs. site-by-site) and franchises for installation
- Eased access to the public domain: building permits & rights of ways – generic national authorisation form to access administration facilities, single applicable documentation form at national/state level
- Environmental considerations: reasonable restriction of installation of equipment in sensitive areas
- Proportionate taxation and fees regime for equipment and sites
- Incentives for deployment of greener and environmental friendly equipment
- Lower/exempt taxation and local fees to encourage deployments, alignment of rental fees with those of other 'essential' infrastructure (water, electricity, gas)
- New roles at the local level: new entities to handle the entire administrative process, including authorizations, certifications (operators' third parties, administrative staff)

While these proposals would require significant changes, in some cases, to the established processes of regulatory and planning authorities, the onus is not all on those agencies to change their ways. There is also the need for the small cell industry to work on areas like standard documentation and equipment definitions, and certification, and to share that work internationally, and with standards bodies and regulators.

In collaboration with industry groups, service providers, and manufacturers, the national and local authorities can work together to facilitate the deployment and adoption of small cells as part of the mobile networks that respond to the growing demand for wireless data connectivity.

6. The stakeholders in the small cells deployment process

One of the factors which adds complexity to the small cell planning, approval and deployment process is the large number of bodies which are potentially involved.

Stakeholders other than network operators, equipment supplier and radio frequency regulator may have a strong interest and a far greater role than in most macrocell installations because of the location of small cells¹. These include the municipal planning authorities but also other interested parties such as landlords, transport operators or property developers.

However, the most significant stakeholders remain the administrative ones: the radio frequency (RF)/telecoms regulators, for spectrum usage and equipment, and the local planning authorities, for sites.

Figure 6–1 summarizes the role of each of these two groups, and the primary challenges associated:

- In the case of the regulators, many are using a framework which was devised for macro radio sites and is not well suited to small cells.
- In the case of the planning authorities, they often have to apply fragmented rules and processes, which were not devised with radio equipment or with huge numbers of units in mind.

INVOLVED AUTHORITIES

THE RF LICENSING AND THE PLANNING AUTHORITIES

RF Licensing Authority	Planning Authority
<ul style="list-style-type: none"> - Can be NRFA, NRA, or the Ministry - They overview conditions attached to the use of specific (licensed) frequency bands and the compliancy and conformity of apparatus with the imposed RF safety norms for the workers and general public - NRAs may oversee the rights-of-way processes, imposing maximal rent fees to access property, public or private, planning exemption of specific apparatus in given conditions - May require equipment taxes imposed by law linked to the annual usage of the RF resources (in corroboration with the MinFin) 	<ul style="list-style-type: none"> - Responsible for the building permits - Scattered at different levels: municipality, local government, local authorities, third parties like gov organisations, 'special' sites - The building approvals documentation may include: certification, declaration of conformity, technical reports, environmental impact assessment, additional approvals of protected sites/areas - Additional activities related to the planning authority: administrative charges, filing for sites access, rental charges, installation and maintenance specific requirements - Contentious settlement
Framework needs to evolve to include the small cells and facilitate their deployment with minimum administrative hurdles	Streamlined processes aiming to decrease the approval time, encourage roll-outs with simplified installation rules

Figure 6–1 The roles of the RF licensing authority and the planning authority in small cell deployment

For both groups, a streamlined framework would make their jobs easier as well as improving small cell deployment at scale, so there is considerable mutual motivation on all sides to examine best practice and evolve new approaches. The next sections

¹ Small cells are deployed in the heart of the town or village, and often very close to people and streets; they may use publicly owned infrastructure such as street lights, but also be installed indoors within enterprise locations or shopping malls.

suggest some possible approaches, based on discussions and developments in real world situations in some parts of the world.

7. Solutions – Certification and approval of equipment (RF regulators)

Before an operator can start planning sites, the equipment must be approved and certified, a process which can vary significantly in different countries. The approval processes may differ in terms of complexity and length in each market; this, added to the cost and time to market, can make difficult the deployment of small cells at scale.

Some authorities have already made considerable progress on standardizing requirements and making some categories of equipment exempt. Mechanisms to avoid delays related to bureaucratic inefficiencies have been implemented, including exemptions for small installations or certain site upgrades, 'one stop shop' licensing procedures, and tacit approval if local authorities do not oppose an authorization request within a certain number of days [7].

When large numbers of items are involved, as in a dense small cell deployment, the roll-out would be greatly facilitated by a system under which all cells of a certain category could be certified for RF compliance and generic approval. This would help achieve the repeatability and standard procedures which enable mass scalability.

In some areas, such regulatory provisions are already in place at national level. In particular, some jurisdictions, based on specific criteria, allow for:

- no specific planning permission requirements for roll-out of certain apparatus
- simple/no declaration regime
- simplified installation rules based on equipment size/installation height

To deploy the forecasted volumes of small cells successfully worldwide, lighter administrative rules would be a significant boost. In markets where categories of equipment can be declared and certified generically at national or even regional² level, there has been a significant impact on ease and cost of deployment.

EXAMPLE 1

In the European Union, responsibility for compliance with regulations (power limits, interference protection, etc.) in low power networks such as Wi-Fi remains with the manufacturer, not with a third-party authority.

In general, the combination of Wi-Fi Alliance certification, unlicensed spectrum and a relaxed approval regime in many areas has enhanced the ability to deploy public WLANs quickly and inexpensively.

Many lessons could be learned for the cellular community. Small cells need to be considered similar to Wi-Fi access points (based on their size and RF power) and thereby:

- Be exempted from planning permissions
- Benefit from simplified local infrastructure policies and design guidelines for installation.

In particular, the small cell community would welcome:

- Simplified procedures to optimize the administrative flow of documentation during approval processes.

² Regional meaning pan-national level, as in the case of the EU region

- Generic declaration of equipment at national, regional or local level. High volumes of individual equipment declarations can be a timely process for both applicants and administration.
- Where declarations are required, a single form available at national level would ease the filing process; if installing several small cells in a defined area, the declaration by batches should be also standardized and generically available.
- Generic certification of equipment based on standardized classes of equipment with harmonized characteristics (e.g. power output, weight limits) would ease the documenting processes; additional documentation could be avoided with standardized manuals and installation rules for each category of equipment.
- Generic criteria for exemption from the approval process – for instance, there could be national or even international agreement on the minimum antenna height, power levels, etc. at which a unit could be exempt from comprehensive approval process.
- Reduced mitigation time in case of disputes (shorter timing and faster settlement than for macro base stations).

7.1 Harmonized small cell installation classes

At this stage, national and international regulations use a broad range of criteria to address the RF compliance of low power equipment installations. This has meant that there is no harmonized approach, which complicates the deployment process for small cells and the rollout of new services.

Criteria for simplified installation processes are addressed in different ways through current regulations. Mostly they use Equivalent Isotropic Radiated Power (EIRP) as the key criteria as well as installation height but the parameters vary greatly between, and sometimes within, countries. For example, the EIRP threshold above which a full site assessment is required typically ranges from 2 W to 10 W but in one country it is 164 W where certain antenna height and separation distances are met. In addition, different criteria may be applied for indoor versus outdoor installations operating at the same EIRP. The technical rationale for the chosen parameters is often not available. There has been no consistent approach between countries, which complicates the task of network deployment and putting into service of new antenna installations.

The detailed evaluation process and technical rationale for RF exposure assessment of base stations is now fully defined by the International Electrotechnical Commission in the IEC 62232 Ed.2.0 standard [19] that has been approved and is expected to be published by mid-2017. The adoption of IEC 62232 Ed.2.0 provides a robust basis to support harmonized regulations. For example, in Europe, it defines the basic principles to be used in the EU for regulatory compliance assessment and provides a framework for the development of the general authorization regime applicable to low power small-area wireless access points in the context of the proposed European Electronic Communication Code.

In [SCF182], the SCF and the GSMA recommend adoption of the installation classes specified by the IEC 62232 Ed.2.0 standard that are applicable to exposure limits based on international guidelines (ICNIRP[8]). They are based on simple installation requirements based on the equivalent isotropic radiated power (EIRP) of all equipment at the site, as shown in Figure 7–1.

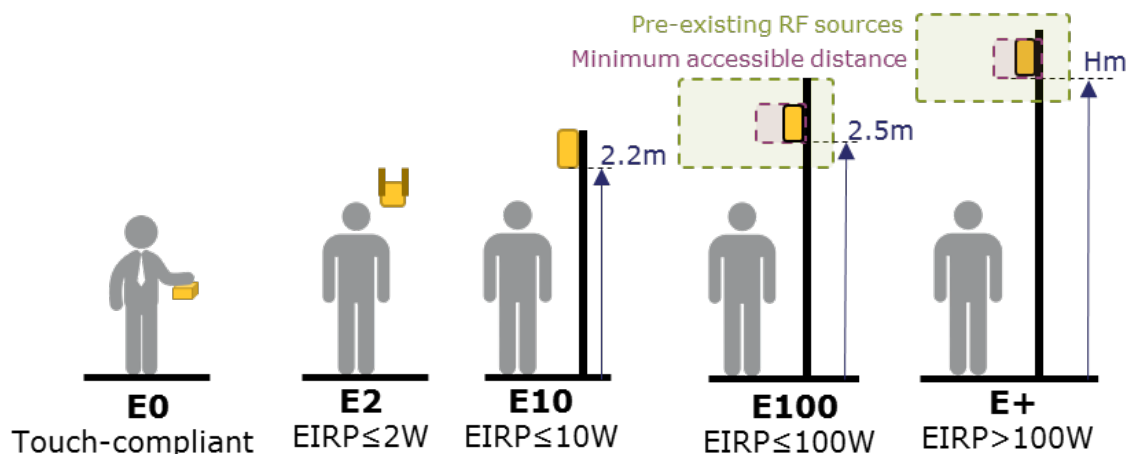


Figure 7–1 Installation classes simplify deployment rules needed for RF compliance of small cell sites

The lowest power devices can be installed with the minimum of design constraints. Touch compliant equipment such as residential small cells can be sited anywhere, much like the mobile devices themselves. For higher power sites, manufacturers' guidelines, minimum height requirements (Hm) and exclusion zones (Dm) must be considered. Site design parameters Dm and Hm should be provided in the product's technical documentation.

Adoption of these harmonised and simplified rules by regulators and policy makers will reduce administrative overheads for both planning authorities and mobile operators. Regions using the IEC installation classes will benefit from expedited small cell deployment and the social and economic benefits of enhanced mobile broadband for all.

EXAMPLE 2

Europe – Simplifying procedures for low power small-area wireless access points

- The European Electronic Communication Code is recommending to facilitate the deployment of low power small-area wireless access points to reduce costs of deployment in very dense areas. Deployment, connection and operation of such equipment should be allowed under the general authorisation regime. The European Commission will define the applicable technical characteristics by reference to the maximum size, power and electromagnetic characteristics, as well as the visual impact. The SCF and the GSMA recommend that these technical characteristics are based on the installation classes defined in IEC 62213 Ed.2.0 see [[SCF182](#)] [9].

USA regulation is continuously evolving with regard to simplified procedures for small antennas, as depicted below. However, local regulatory and administrative law and rules at each federal state level add complexity in dealing with small cells deployments.

EXAMPLE 3

USA – simplifying procedures for small cell siting policy

In the USA, the FCC has repeatedly recognized the extraordinarily promising benefits of such 5G services and has acknowledged the need for deployment of small wireless facilities, such as small cells.

WT Docket No. 16-421 published in December 2016 invites public input on potential Commission actions to help expedite the deployment next generation wireless infrastructure by providing guidance on how federal law applies to local government review of wireless facility siting applications and local requirements for gaining access to rights of way.

The docket builds on previous efforts made by the FCC, which in turn were based on Congressional amendments to statute. In prior decisions in 2009 and 2014, the FCC clarified its view of a variety of sections of the statute, including defining a reasonable period for local review of siting applications. The new Public Notice allows the FCC to develop a factual record in order help assess whether and to what extent the process of local land-use authorities' review of siting applications may continue to hinder the deployment of wireless infrastructure, and to determine if there are additional interpretations of statute that will assist in resolving siting delays.

Note: A full update on the legal changes around the world with regard to small cell regulation, since 2008, can be found in Small Cell Forum's document [[SCF076](#)] [[10](#)].

8. Solutions – site identification and planning permission (local authorities)

In the view of many operators (see Chapter 4, Figure 4–1), the greatest bottlenecks to large-scale deployment of small cells are linked to site identification and achievement of the planning permission. These areas require the greatest efforts - from both the industry and the administrations - to evolve towards a simplified, standardized and repeatable set of processes to support the massive build-out, timely and where required, as well as the objectives of the national or municipal administrations.

Small cells and HetNets must be positioned to support targeted coverage, for instance in urban canyons, shopping areas, etc.

Streamlined, standardized processes are ideal for scale purposes and would allow small cells to be placed in the heart of the city and close to users. Communication between stakeholders, from early stages, to discuss and alleviate concerns of all sides, is essential; examination of good practice round the world would build regulator confidence.

Concerns linked to the roll-out may span over several densification issues, such as:

- Precision of location: Large-scale deployments of outdoor small cells in the 5G HetNets can demand for precise siting. As greater density of the small cells drives the size down of the equipment, which will call for greater precision in cell position near the location where the services are being consumed.
- Handling of siting approvals: Large-scale deployment of cells in a hyper-dense HetNet environment will call for a large number of siting approvals.
- Heterogeneity of planning processes: Planning policies fall under the responsibility of local public entities and can differ widely, depending of the local situations and peculiarities.

The above considerations can lead not only to a vast number of precise locations to handle, but also the increasing number and complexity of applications for operators, and evaluation and approval on the administrations' side. Such situations will virtually lengthen the administrative processes in the disinterest of the availability of services.

Across the globe, there is a wide range of legal and waiting periods for the approval process of RF sites, with a best practice of 20 days in New Zealand, but 3-6 months being more common in many other countries such as the US, UK and Italy. Figure 8–1 offers a synthesis of the similar procedures in the EU [8].

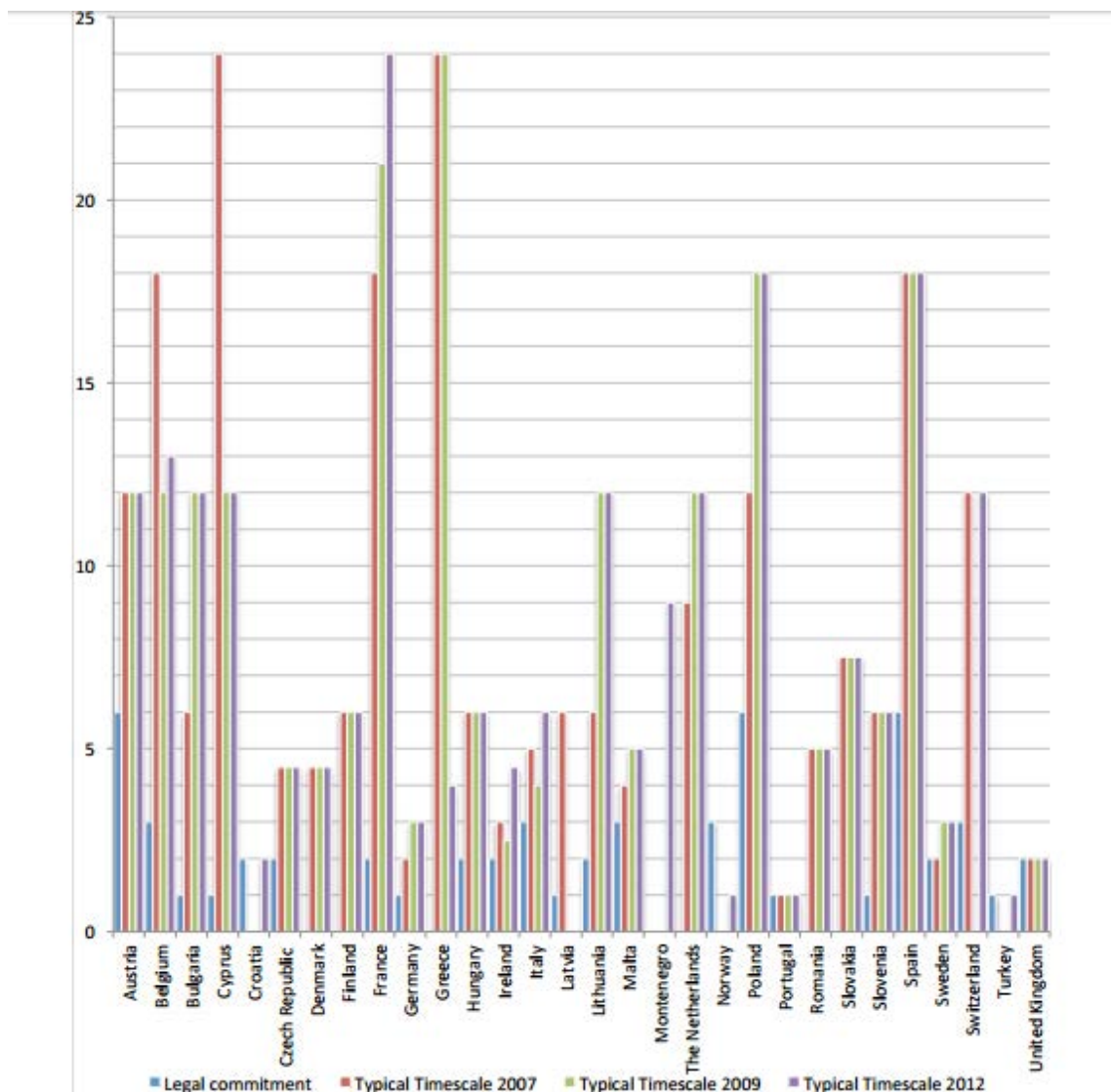


Figure 8–1 Legal requirements and typical timescales for permission to deploy base stations in Europe (in months)

Source: GSMA

In Latin America, the municipal-level permitting stands as the biggest challenge for the deployment of new wireless tower infrastructure [11]. In recent years, governments in Brazil, Colombia and Peru have approved and sanctioned new regulations that seek to standardize and simplify wireless infrastructure permitting procedures, and eliminate bureaucratic obstacles for the timely deployment of wireless infrastructure, including wireless towers.

EXAMPLE 4

BRAZIL - A complex and incomplete legislation

Amid the economic situation, Brazil is taking significant steps to contribute to the proper development of the telecommunications infrastructure in the country, in order to facilitate and encourage their implementation, expansion and modernization.

Several actions have been taken in the last years in this direction: in December 2014, the Senate approved the small cell tax break bill, followed later in April 2015 by the endorsement of the Law of Antennas (Law 13,116 / 2015) that streamlines the license for the telecommunications antenna installations.

The 2014 Small cell tax break bill extends the range of small cells equipment entitled to exemption from the Fistel telecommunications fee, for equipment with transmission power up to 5W. Previously, only equipment below 1W were exempt from Fistel, the fee charged by the telecom regulator Anatel to operators per transmission units installed. Equally the equipment transmitting between 5-10W will see their Fistel fee reduced.

Additionally, the General Law of Antennas of 2015 proposes a simplification of the process and establishes a maximum period of 60 days for licensing, equally recommending that the upgrade of municipal legislation to address specific deadlines to streamline the licensing process. The granting of authorization is handled by a single body, without prejudice to other municipal administrative bodies that may occur during the processing period. Without the manifestation of charge during the 60-day period, the license shall be considered approved (tacit licensing approval). Under the current law Anatel has to define the technical parameters for installation, maintenance and removal of the towers, and the supporting infrastructure.

Despite the intention of the antennas Law, the main challenge remains the difficulty of harmonizing the Union's competences with the performance of states and municipalities, with regard to the laws and urban policies associated with the installation of telecommunications networks in the country.

While the overall context is rather complex – a survey conducted by the National Union of Telephone and Mobile and Personal Service Companies (SindiTelebrasil) revealed the existence in Brazil, more than 250 laws that restrict the installation of towers and antennas, each with its own requirements and obligations imposed providers and holders – Brazil is paving its way towards establishing a better legal framework of the telecommunications infrastructure.

The situation can be also complex when targeting city deployments of small cells. Several generic rules spanning from national to state and local level are applicable, and operators planning small cell deployments need to consider and comply with all these requirements. For example:

- Under the national/federal laws, the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA) are dealing with environmental assessments and historic sites preservation. Section 106 of the NHPA requires that the FCC take into account the effect that issuing a license will have on historic properties. This involves review by State Historic Preservation Officers (SHPOs) and Federally recognized tribes. As noted in Example 7 below.
- At state level, for example, New York's Environmental Conservation Law and State Environmental Quality Review Act (SEQRA), could potentially apply to the placement of small cells in New York City. SEQRA can apply any time a local

government permit or approval is needed to make an installation or perform construction. However, New York City has its own sub-process, called City Environmental Quality Review (CEQR), that governs New York City's obligations under SEQRA.

- The local level includes zoning, code, and permitting requirements; the NY City Zoning Code and City Code are to be considered when deploying metro cells as well as prior approvals from the Department of Buildings.

EXAMPLE 5

A New York Tale – a streamlined process

New York City has established Mobile Telecommunications Franchise Agreements that allow companies to 'install and operate telecom equipment on street light poles, traffic light poles, and utility poles to facilitate wireless communications in the five boroughs' [12]. These agreements feature a relatively low fee structure and streamlined processes for review of small wireless facility siting applications.

In many cases operators deal with these administrative issues through local partners and, for the small cells, the role of the subcontractors can evolve in different models. One specific example is the 'acquisition, design, and construct' model in UK, where local agents control 'under one roof' issues like site selection, local planning consultations, and application submissions. The role of such entities is to establish relationship with the local administrations and continue working with them on regular /yearly basis. However, national applicable policies would help harmonizing working patterns between operators and/or their third parties and the local administrations.

The following list summarizes the various administrative requests that may apply:

- Equipment/system RF exposure limit certification, and eventual installation and services authorization, although some exemptions may apply
- Applicable national, regional, and local permits for installation and service operations
- Sectoral regulatory consideration
- Environmental considerations: planning requirements for areas like historical buildings and preserved areas, or national parks
- Building permits: owner property authorization, public domain rights of ways, and other eventual mutualisation requirements. For instance, strand mounted Wi-Fi has been successful in the US because cable operators have the right of way.
- Applicable taxes and fees: national and/or local taxes and fees may be applicable under the form of equipment installation taxes, administrative fees, one-off and/or annual fees

Key elements to scaling small cells deployment are streamlined requirements and supportive regulation and rules at national and local level. Yet this list indicates the wide range of considerations and stakeholders which are involved. Given the number of entities that might be involved at the national and local level, the amount of paperwork required, along with the length of some processes, creates severe delays.

8.1 Recommendations for streamlined processes

A generic scope for planning with streamlined processes can assure the scalability required when deploying hyper-dense networks. Recommendations include:

- Installation procedures for small cells should be developed and established based on internationally accepted equipment classes, referenced similarly by the national administrations. The internationally accepted reference would enable generic permits for installation and operation.
- Scaled-down administrative processes applicable to small cells will speed up the administrative flow of documents for local planning approval and will allow faster roll-out.
- Streamlined process for small cells siting should consider, whenever possible, easy access to public and governmental properties for installation of such equipment.
- National-based rules regarding the rights-of-way for the deployment of small cells need to be considered for both the access to the property and administrative paperwork. Applying same policies on national basis will simplify and incentivize the roll out of denser network.
- Grant access to administrative buildings with a preferred regime will encourage, where possible, the use of these facilities vs. private locations.
- Ideally, a municipality could conduct a census of all available locations suitable for installation (to ease the classification based on power, fibre facilities, etc.)
- Put in place specific rules only for specific areas (military, historical sites, preserved natural spots), where installation might reasonably be restricted.

9. Solution - Using different types of sites

The massive scale of hyperdense small cell networks will require large numbers of qualified sites, plus more precise locations than macrocells, which results in less flexibility in choosing and gaining access to the appropriate site.

The challenges of precise siting requirements can be mitigated by various new approaches, which may also help to reduce administrative overhead:

- Mounting on a widening variety of existing structures (buildings, rooftops, street furniture)
- Use of alternative indoor locations
- Sharing of sites or a neutral host platform

It will be important for all stakeholders to take a creative approach to new types of sites, since in hyperdense situations, even solutions like roofs or light poles may be insufficient in number, at least in the right locations. The availability of qualified sites will therefore become a rising concern.

Despite efforts to streamline the regulatory and policy frameworks, the deployments encounter hurdles as the rules at local level are not yet completely coordinated with the national/federal ones, and access to sites is in some situations difficult.

EXAMPLE 6

USA – Access to municipal and cooperatively owned poles

Section 224 of the Communications Act, which provides wireless carriers with reasonable access at fair and reasonable rate to utility poles, does not apply to municipal and cooperatively owned utility poles. Until the Congress changes Section 224 to include those poles, the FCC should consider issuing guidance or best practices recommendations to municipalities and coops to promote wireless broadband deployment, particularly in dense urban areas where hundreds of nodes may be needed. Such guidance could make clear that prohibition on use of municipal owned light poles, excessive fees for attachments, unreasonable distance limitations for zoning in rights of ways, exclusive access agreements with a single carrier, and not allowing batch filings impede the small cell deployments.

Alternative developments will be valuable, especially if a generic planning permission process can be established for an entire category of sites, such as traffic lights. As such, engaging with the owners of many types of street furniture are important, as they can open up alternative locations: light poles, street signs, billboards, bus stops etc. Generic processes relate therefore to both publicly owned infrastructure and some private assets.

Virgin Media UK and Swisscom in Switzerland have even deployed small cells in pavements or under manholes, where they are invisible and can support ubiquitous coverage and specific applications such as smart parking.

JCDecaux integrates small cells into its billboards, which has several advantages, as:

- The billboards are plentiful, close to centers of population, and already installed and powered
- The small cells are almost invisibly installed
- JCDecaux is accustomed to negotiate with cities for a large portfolio of locations for its billboards, and has its own streamlined frameworks for

agreeing large numbers of site approvals. As such, a large part of the approval process is already achieved.

Other examples of owners of site portfolios include:

- transport operators (railside or roadside sites, backhaul and infrastructure)
- existing mobile towercos which are amassing portfolios of smaller sites under standard agreements (e.g. Arqiva in the UK, Crown Castle in the US)
- public utilities which control light poles, powerlines and other infrastructure.

Any owner of a large portfolio of sites is well positioned to negotiate a blanket agreement, with standardized terms and conditions, with an operator. This is beneficial to operators as much of the administrative burdens can be passed to the sites owner. These entities often have the advantage of existing streamlined frameworks for agreement with local authorities and other stakeholders.

9.1 The role of neutral host/multi-operator deployments

One way to ease the approval and deployment process, and ensure the final network is free from interference, is for a single network to be shared by several operators, rather than multiple separate systems needing to be built. This can be done as a sharing agreement between mobile operators, or via a neutral host which deploys the infrastructure and then signs deals with the mobile operators and potentially other providers.

In most cases, these approaches involve spectrum sharing. Operators spend a lot of money on spectrum, and are often unwilling at first exposure to let their competitors have access to it. But this reluctance fades for two reasons – the reduced cost of the infrastructure, where up to six networks can be served for the price of one, and where the spectrum is underused anyway, and the owner can earn revenue they would otherwise miss, by carrying traffic on behalf of a competitor, by measuring it and charging for it.

Historically, spectrum sharing has not always found favour with regulators, since it has often been viewed as a potential threat to healthy competition between national operators. However, the research undertaken during the production of this report indicates that several countries around the world have already authorized the use of active network infrastructure sharing including RAN/spectrum sharing in certain circumstances. This has been allowed, or even encouraged, in some countries where regulators have had strong policy objectives to extend mobile broadband coverage to areas of low population not likely to be served by multiple competing networks. The regulatory mechanisms by which this has been achieved are not always clear and vary from one country to another although some broad themes emerge.

One relatively straightforward route adopted in several countries has been for participating operators to form a joint venture (JV) at the time of a national spectrum award. The JV has then applied for a licence to operate a network across a range of frequencies, thereby permitting spectrum pooling and variable distribution between the individual participating operators.

Alternatively, in countries where a fully liberalized regime is in place, spectrum trades have occurred subsequent to the original award process, to enable transfers of spectrum rights from existing licence holders to a new JV. Both these approaches do, however, pose the risk that regulators and competition authorities may bar such applications or trades if distortion of competition is judged to be a significant risk.

Nevertheless, there are several examples whereby such deals have been accepted and this is especially likely to be the case in developing countries or regions where policy objectives to extend broadband coverage may outweigh competition concerns.

Newly emerging regulatory frameworks may bring additional opportunities for multi-operator small cell operation in spectrum currently occupied by military and other incumbent applications. The licensed shared access (LSA) concept developed within the European regulatory framework is one approach which may enable shared spectrum authorizations to be applied for. A similar approach called authorized spectrum access (ASA) has been adopted in the United States which is primarily targeted at small cells. This is exemplified by the new CBRS service in 3.5 GHz (see below).

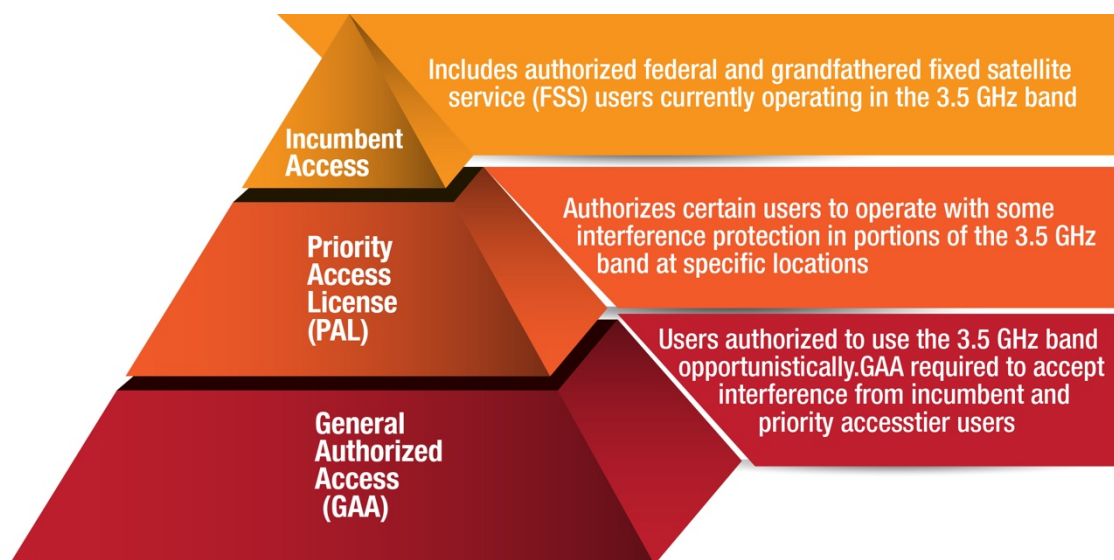


Figure 9–1 The 3.5 GHz ASA sharing scheme (CBRS) in the United States

The neutral host concept can take various models depending on the underlining regulation and its success needs proven. However, as networks evolve towards 5G and the access to high millimetre wave (mmWave) frequencies, sharing concepts may evolve to accommodate neutral host in dense urban environments, whether indoor or outdoor. Spectrum management for high bands, combined with a thoroughly developed operational model will highly influence adoption of such models like neutral host, SCaaS or MSA.

10. Solutions – installation

When regulatory and site permissions have been obtained, the next challenge is to install the cells in an efficient, quick and affordable way. The ability to do this may also depend on negotiation and cooperation with local authorities, especially when using publicly owned sites.

Physical cell installation in large scale HetNet deployments can be a challenge due to permits needed, equipment transport and installation, and large numbers of cells requiring set-up/ configuration. In some countries, it may be required to use workers employed by the local authority, or qualified by it.

Solutions, which involve new processes both for operators and municipalities, include:

- Lean cell site approaches, in which there is considerable advance base station set-up/provisioning in order to avoid site disruption and minimize time to perform installation.
- The use of standard classes of equipment and their installation rules can ease the installation, operations, and maintenance burden and alleviate concerns on perceived risk for workers. The installation rules attached to the equipment class indicate the level of knowledge and skills the workers require to make the respective installations. Such provisions open up the installation of certain classes to a larger community of generic workers, with an easy guide of installation, while reserving the more powerful equipment installations to trained personnel.
- Per-class deployment recommendations can reduce the complexity of O&M as well, and so decrease part of the costs of deployment and maintenance associated.

With intensification of the HetNet deployments new local level roles and dedicated activities can emerge, such as a ‘street manager’ directing a workforce which is proficient in rapid, high volume, street-level roll-outs, treating small cells as urban furniture.

11. Other regulatory issues

Sites and installation are not the only areas where regulatory and municipal authorities intersect with operators over small cells. Other important examples include:

- Compliance with radiofrequency exposure limits
- Taxation and fees
- Smart city initiatives

11.1 Compliance with radiofrequency exposure limits

Along with visual integration issues (addressed in Chapter 3), another topic which creates community interest related to small cells is the topic of radiofrequency exposure. If reliable information is not available there could be public opposition or even obstruction by local councils.

The consensus conclusion of independent expert reviews is that there is no convincing scientific evidence of a link between public exposure to low level radio signals generated by small cells and adverse health effects [13]. This is an area where local and central government can work with the industry to address community questions.

A transparent exchange of information between authorities and operators is in place in most of the countries, as RF authorities require operator declarations of network infrastructure compliance with relevant national or international guidelines. The guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) are widely adopted by national authorities around the world. Such certifications should suffice for local authorities to allow deployments.

Declarations of compliance should be the de facto usage and post-installation measurement rather the exception, done by RF authorities as part of random audits of compliance.

11.2 Taxation and fees

Another area where some local authorities could consider changing their rules to ease the path of small cells is in taxation and fees. As shown in some earlier examples, several taxes and fees are scattered with different entities involved in the siting and deployment processes.

For harmonizing and lower the taxation and fees burden, recommendations include:

- Apply proportionate taxes for small and their respective sites rental fees. As volume deployments are foreseen for small cells in the ultra-dense networks, the actual roll-out will depend on the financial robustness of the business case. For site rentals, a two-pronged goal should target:
 - proportionate fees for small cells vs. macro base stations, and
 - alignment of telecom rental fees with those of 'essential' infrastructure utilities like gas, water and electricity.
- Lower / exempt taxation and local fees to encourage deployments by aligning rental fees with those of other 'essential' infrastructure (water, electricity, gas). E.g. In December 2014 Brazil passed a law which extends the categories of small cells entitled to an exemption or reduction of the Fistel

telecommunications fee. In UK, the government [14] is evaluating ways to align rights of access for telecom infrastructure rollout to those of utilities like water and electricity. Given the priority that the Government attaches to digital communications and investment, and the ever more vital role this plays in economic growth, productivity and social interaction, a more radical reform is appropriate to limit the value of consideration to rates that are more relevant to modern infrastructure rollout.

- Remove specific deployment or spectrum usage fees for small cells, as most deployments are meant to augment existing capacity of networks.
- Provide financial incentives for the deployment of environmentally friendly networks; this would impact on green initiatives while boosting small cells, which operate at low power. Additionally, (SON based) dormancy features [15] can further diminish the diminish energy consumption and save significant amounts of power.
- Adjust rental fees for private properties, by setting by law the maximum price

In some countries, for historical reasons, specific situations have to be handled in respect to the legacy tribal considerations, as in the case of New Zealand or USA. Whether it is about heritage and request for reservation of radio waves or access to property, these issues have to be addressed with respect to the situation but also in a manner that assures that quality of service and coverage of telecom networks is achieved. The national laws existing in such cases should be completed with detailed recommendations or procedures as to avoid lengthy administrative processes and eventual litigations.

EXAMPLE 7

USA – Access to tribal properties

The National Environmental Policy Act (NEPA), 47 C.F.R. §1.1307, requires proposed new and modified wireless facilities to be reviewed for impact on historical properties. The reviews must be conducted in accordance with Section 106 of the National Historic Preservation Act (NHPA) and involves review by State Historic Preservation Officers (SHPOs) and Federally recognized tribes. The FCC has excluded many types of deployments from these Section 106 reviews, but gaps still exist and create barriers to small cell infrastructure deployment.

One issue lays with the fact that delays in the tribal review slow down broadband deployment.

Under existing FCC rules, if a tribe does not respond to a proposed new or modified facility request after a period of time, there is a process for a deemed approval. However, no formal process exists to obtain approval from tribes that have responded with interest in consulting on the proposed site, but never actually provide input. The FCC should establish a timeline for tribal review and deem approved any review where a tribe fails to meet the timeline.

In their 2014 Infrastructure order [16], the FCC notes that although these review requirements serve important local and national interests, local and Federal review processes can slow deployment substantially, even in cases that do not present significant concerns. Consequently, in their recent call for comments, the FCC is seeking feedback on how often are applications denied on the basis of:

- (i) their inadequacy or incompleteness;

(ii) engineering defects or other technical problems; (iii) environmental impacts; (iv) aesthetic concerns;

(v) perceptions of excessive or overly dense deployment of wireless network facilities in particular areas;

or (vi) other reasons?

11.3 Smart cities

As the idea of smart cities develops, there will be increasingly close relationships between local government and small cell roll-outs, which may enable smart city services which require density, such as vehicle-to-infrastructure services or public safety.

The growth of smart cities is likely to be a catalyst for some local authorities to pursue innovative approaches to small cell siting, in order to support the services they require. This may also lead to greater sharing of resources, such as personnel, and of costs and revenues in some circumstances. There may even be cases where the local authority acts as a neutral host platform for a small cell network, with its own applications as the 'anchor tenant'.

That might encourage the idea which is put forward by some parties, of a coordinating role within the city which would place all the various approvals and processes associated with small cell deployment in the hands of a single executive and team. Smart city projects are already starting to lead inevitably to this kind of reorganization, and it will be important for small cells to be included in the 'smart city director' remit.

12. The role of the small cell industry and of the Small Cell Forum

As mentioned earlier, progress towards a simplified, unified and streamlined approach to facilitate large-scale small cell deployments will come from increased communication and cooperation between all the stakeholders. The onus is not all on authorities to change their ways – the operators and small cell vendors also have a significant responsibility and role to play.

Much of this is about communicating – providing regulators and municipalities with the information they need to make appropriate decisions and working to alleviate their concerns.

Example 8

The GSMA [7] has identified seven policy recommendations to support efficient small cell deployments:

1. Follow the internationally harmonised small cell power classes when developing regulations related to compliance with radiofrequency exposure limits.
2. Adopt simplified procedures for building permits for small cells (if required) based on standardised size, installation requirements and radio characteristics.
3. Accept declarations of compliance and do not require routine post-installation measurement.
4. Exempt small cell installations from location registration requirements.
5. Reduce permit costs for small cells relative to those for macrocells.
6. In respect of RF compliance provide information for consumers and local authorities based on WHO materials and recommendations.
7. Facilitate access to existing structures, electrical power and data backhaul.

However, collaboration between authorities and industry must be continuously developed and encouraged, as much of the work on devising commonly agreed equipment specifications, certifications, documentation and installation instructions – agreed to be the starting point for simplified regulation – must come from the industry itself, acting in a collaborative way. These inputs will serve authorities to elaborate laws and regulation that take into account, reflect, and accommodate technological evolution and trends.

In addition, the small cell industry must actively engage with operators and local administrations, associations of mayors, and national regulators to establish or update codes of best practices, guides for the local communities, etc. For example, the French regulator ARCEP established a dedicated group for communities, GRACO (Groupe d'échange entre l'Arcep, les collectivités territoriales et les opérateurs), aiming to facilitate telecom related planned developments and their impact on local communities.

12.1 The role of the Small Cell Forum

Small Cell Forum plays a vital role, providing a central hub for communication between all the industry stakeholders and a unified voice to build trust and best practice with regulators, administrations and cities.

The Forum is supporting and drives the central goal of achieving a common small cells classification, to underpin and enable changes in regulatory practice with the benefits summarized in Figure 12–1.

OUR GOAL: A COMMON SMALL CELLS CLASSIFICATION

INDUSTRY SUPPORTED INITIATIVE

Harmonized equipment classes derived from IEC 62232 Ed 2.0

Commonly accepted classes of equipments based on a set of parameters (output power, equipment size*, installation height) leading to safety and installation recommendations manual

Benefits :

- Streamed-down administrative process per equipment classes:
 - Generic declarations of conformity / compliance (RF, certification, etc.)
 - Uniform administrative papers filing
 - Definition of generic installation rules (and best practices), maintenance and troubleshooting
- Ease of identifying categories of public / private partners for deployment and establishment of standard procedures:
 - Cross regional documentation for installation
 - Generic authorizations for installation spanning over larger areas (regional) and types of buildings (governmental)
 - Generic installation rules per type of equipment facilitating the installation and maintenance
- Ease of promoting with the general public, directly or via the local authorities (small cells densification as being compliant with the rules of safety, compliance norms)

* Size: standardized dimensions, volumes, weight, or combination of them

Figure 12–1 Summary of the benefits of the core goal of a common small cells classification

In addition, the Forum is developing best practice guidelines for states, regulators and municipalities in collaboration with 5G Americas in North America, GSMA in Latin America, and through working with leading carriers in the Middle East and Asia. In Europe, the Forum lately prepared its response to the UK Digital Economy Bill, and will follow closely the review of the European Council and Parliament of the European telecom framework, the Electronic Communication Code that contains regulatory proposals aimed to facilitate the deployment and operation of small cells. At the same time the Forum is continuing to urge national governments to strengthen deployment provision in support of the societal and commercial imperatives.

Right now SCF's regulatory objectives are:

- To encourage a consistent regulatory environment in a wide range of administrations, giving operators and vendors access to wider markets and thereby generating economies for providers and consumers alike.
- To assist national and local administrations in understanding the regulatory issues associated with small cells and, where necessary, to clarify regulations to enable their citizens to gain full access to small cell services.
- To ensure that any necessary clarification is identified and dealt with ahead of the time at which operators wish to provide services, permitting the benefits to be achieved in a timely fashion.
- To provide Small Cell Forum members with knowledge of the status of the regulatory environment for small cells across the world.

'While the air interface continues to dominate industry discussion, the biggest challenges in rolling out the dense networks associated with 5G lie in the underlying network architecture and fragmented and outdated national regulatory frameworks,' said David Orloff, Chair of the Small Cell Forum. 'We are actively engaged in defining

operator and vendor priorities for bringing interoperability and consistency to the enabling technologies that will be the foundations for 5G networks. At the same time, it is critical that the industry works in conjunction with regulatory bodies to create an environment in which these networks can be swiftly and cost-effectively deployed.'

13. Conclusion

Densification and small cell initiatives which are starting now with LTE-Advanced will lay the foundations for migration to 5G as that emerges. In every aspect of the network, from radio to services to the logistics of sites and installation, the move to 5G will be easier if operators start now to introduce new approaches and processes.

In 5G, there will be a move to extremely dense networks, with heavier use of high frequency spectrum and the ubiquitous coverage required by many emerging IoT applications. That will increase the demands on sites and on streamlined, automated deployment processes. Technologies like SON [17] and virtualized RAN will become essential to enable the roll-out and management of huge numbers of cells and the rise of vertical market IoT networks will usher an even greater variety of stakeholders into the mobile ecosystem.

It is therefore essential for regulators and the industry to consider the best processes and rules now, at an early stage of densification, so they have a strong body of unified frameworks and best practice, before the even greater challenges of 5G kick-in.

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